Confinement of transgenes – seeds and volunteers

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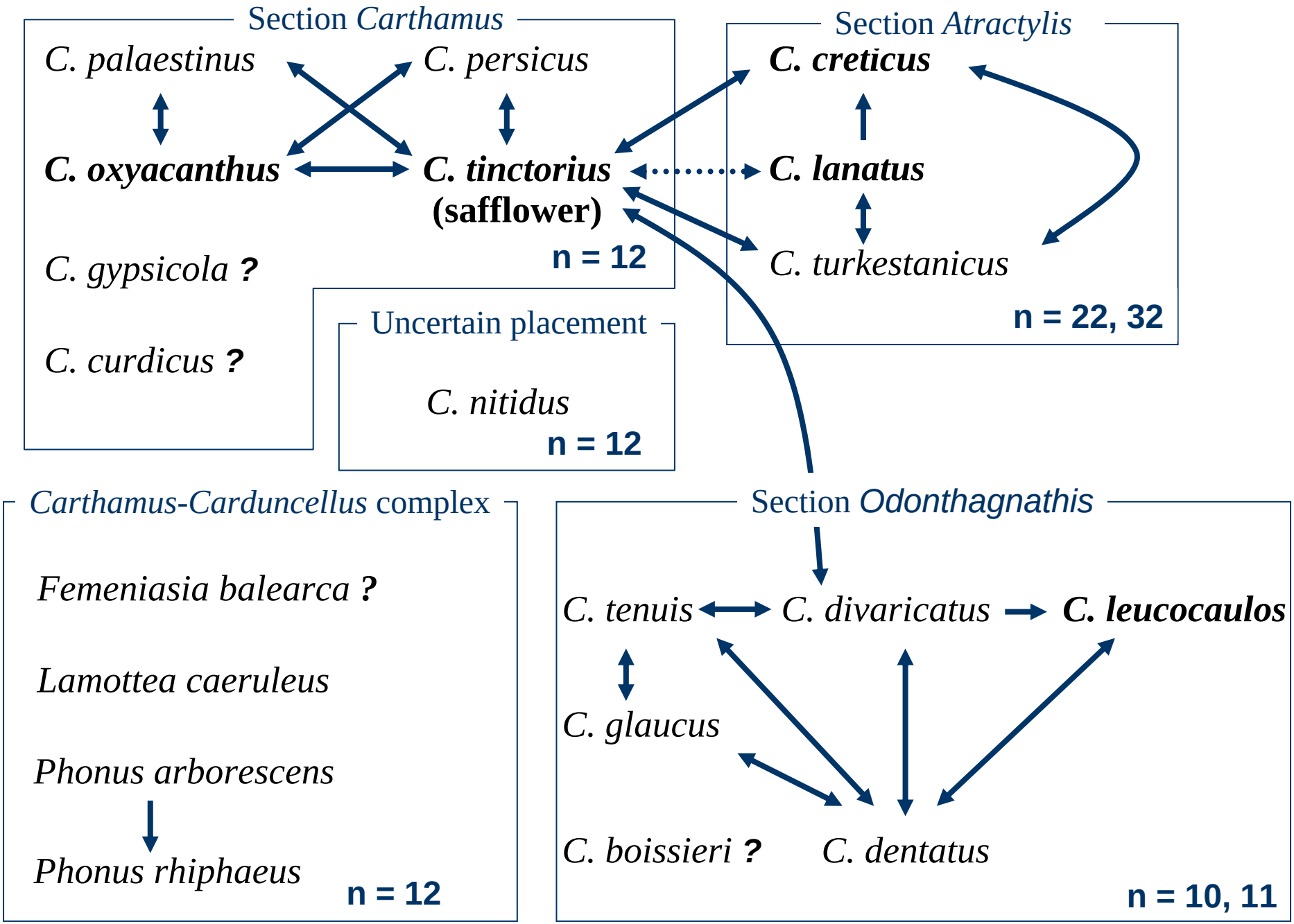
McPherson MA, Good AG, Topinka AKC, Hall LM. 2004.

Theoretical hybridization potential of transgenic safflower (*Carthamus tinctorius* L.) with weedy relatives in the New World. *Can. J. Plant. Sci.* 84: 923-934.


Section Carthamus
C. palaestinus
C. persicus
C. oxyacanthus
C. tinctorius
(safflower)
n = 12
C. gypsicola ?
C. curdicus ?
Uncertain placement
C. nitidus
n = 12
Section Atractylis
C. creticus
C. lanatus
C. turkestanicus
n = 22, 32
Carthamus-Carduncellus complex
Femeniasia balearca ?
Lamottea caeruleus
Phonus arborescens
Phonus rhiphaeus
n = 12
Section Odonthagnathis
C. tenuis
C. divaricatus
C. leucocaulos
C. glaucus
C. boissieri ?
C. dentatus
n = 10, 11

Spatial and temporal gene flow

Pollen

Seed

Seed Handling

Volunteer Crops

Introgression Relatives

Adventitious presence conventional crops

Admixture

Weedy or invasive

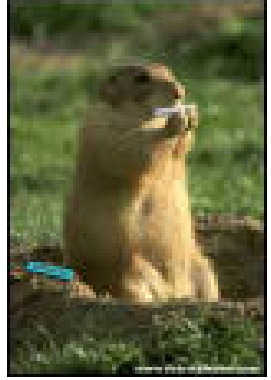
Admixture

Safflower Seeds

- 80,000 ha in the USA
- <1,000 ha in Canada
- Used as birdseed
- (no food use in Canada)
- Oilseed in USA
- Glufosinate resistant
- PMP platform

Seed dispersal

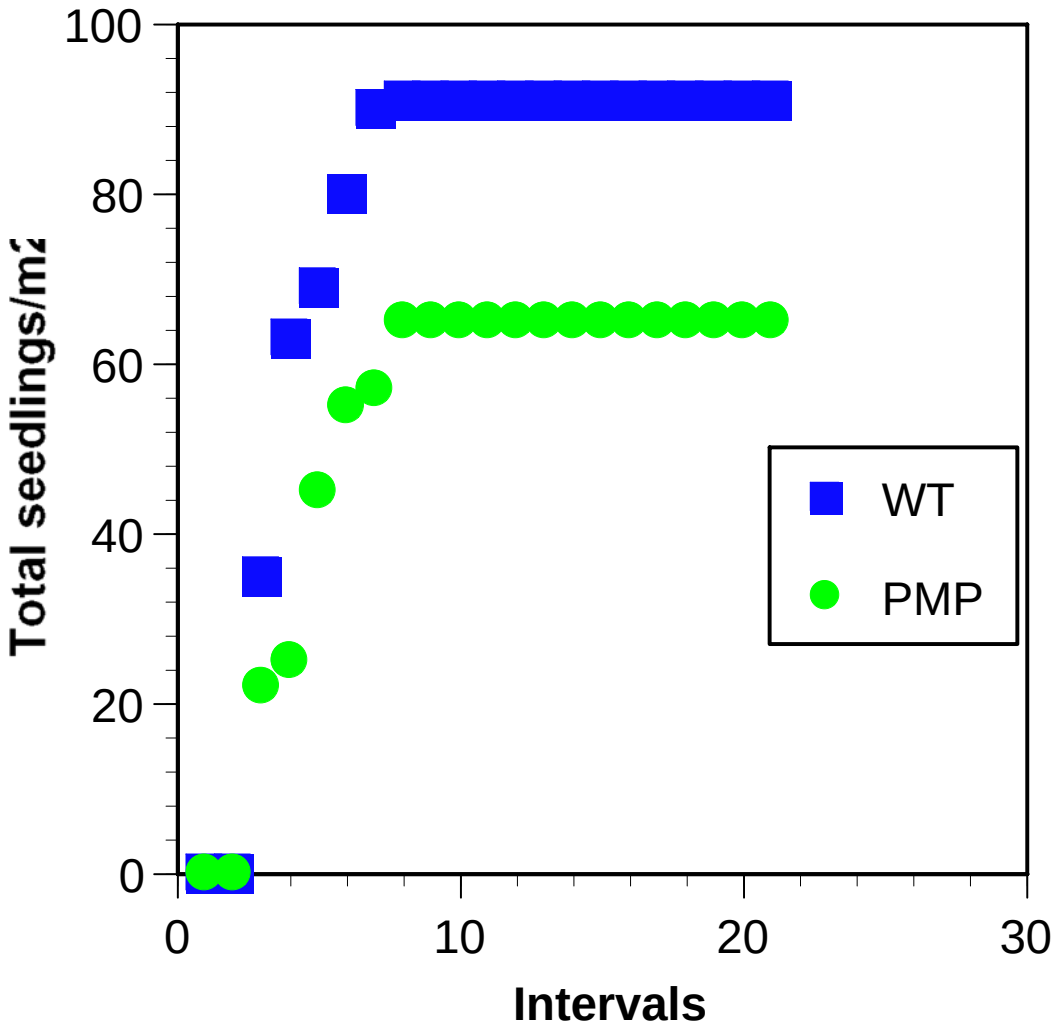
Seed dispersal



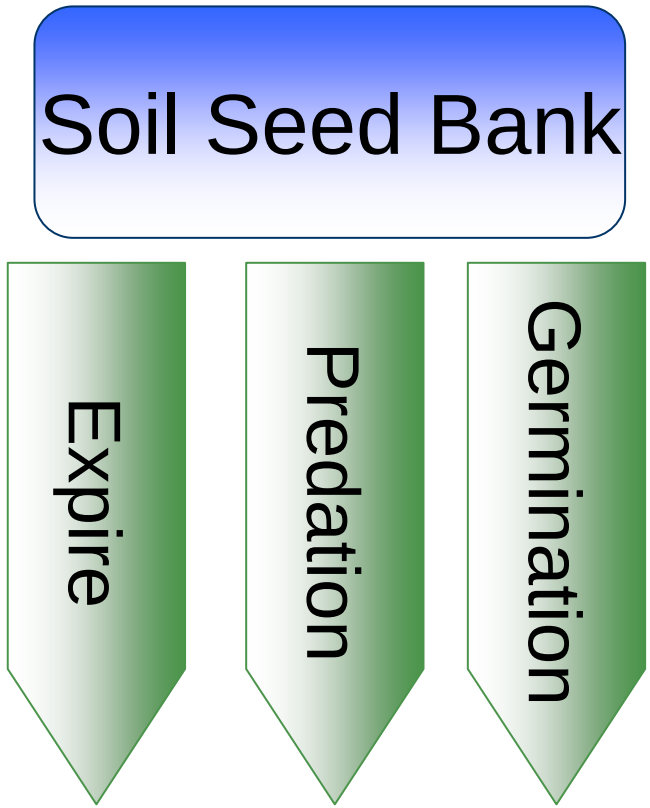
- Seed on the surface can be removed and dispersed by small mammals and birds
- 500 plants/m2 spread on the surface prior

ng

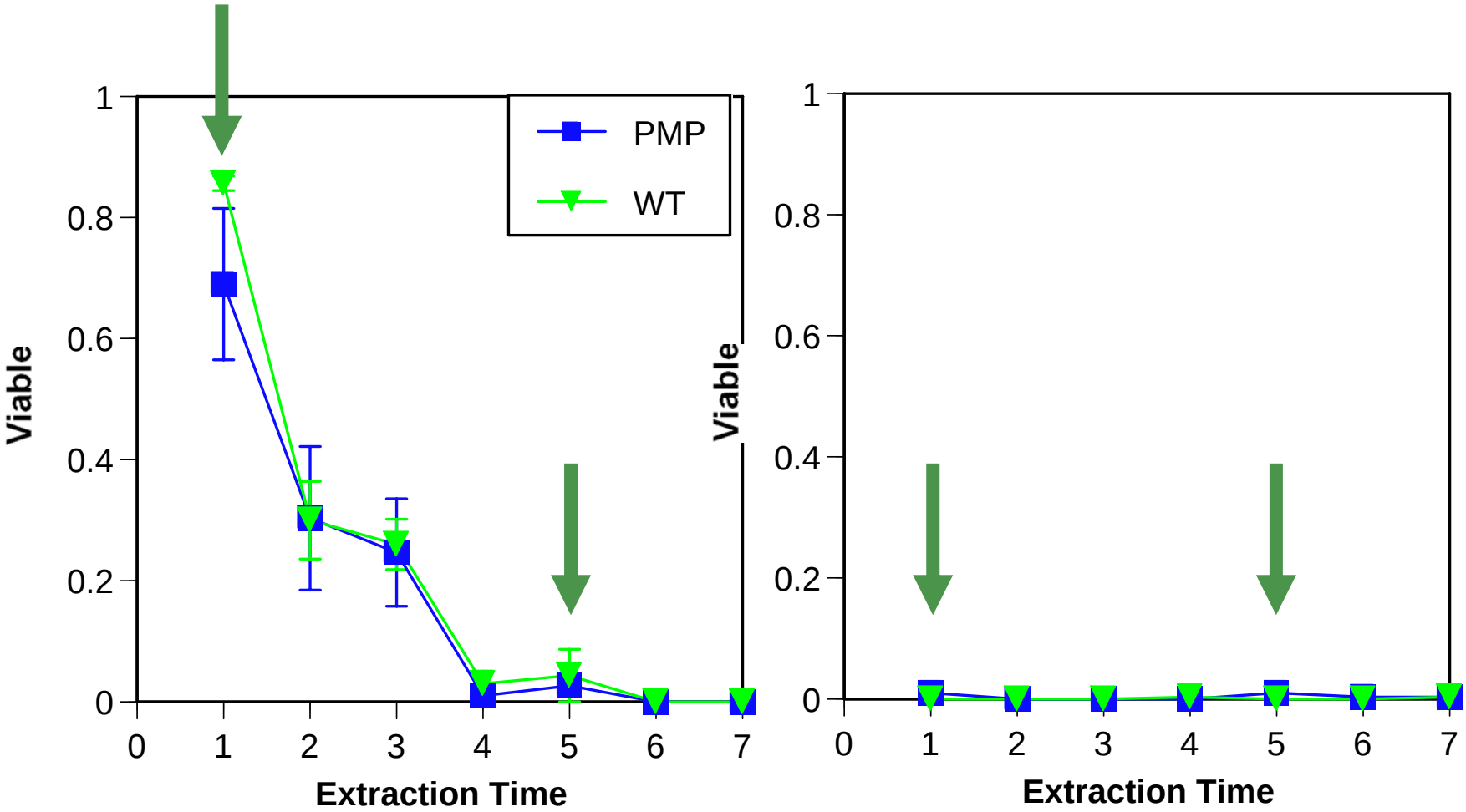
Seedlings germinating



Seed dormancy



Viability of safflower seed enclosed in seed packages, surface and 2 cm depth



Seed longevity in the seed bank

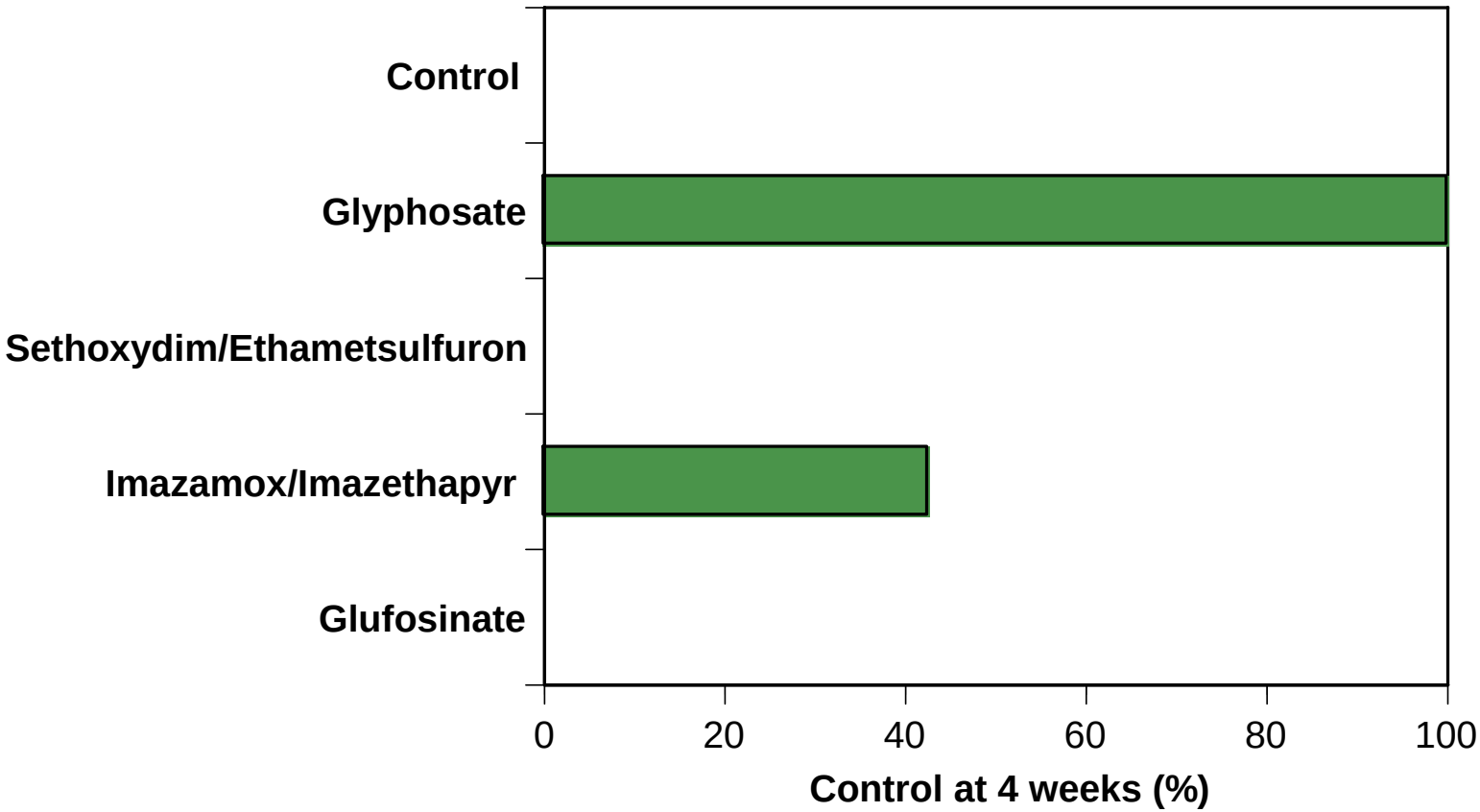
- Little innate dormancy
- Limited secondary dormancy

- Depends upon
  - Predation
  - When the seeds enter the seed bank
  - Depth of burial
  - Soil moisture (threshold)
  - Soil temperature (determines time/rate)
  - Light

Safflower volunteers

Safflower as a volunteer crop

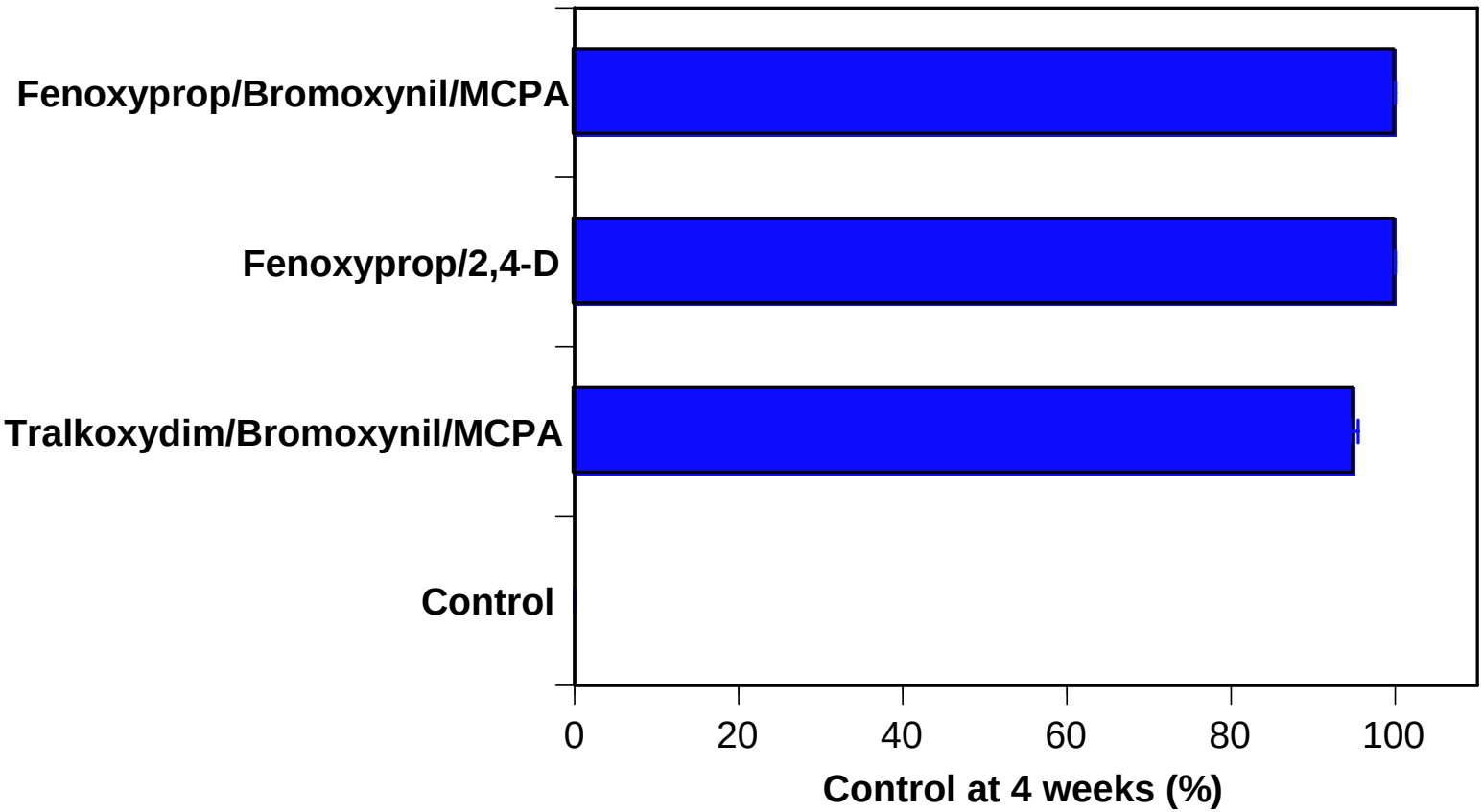
Herbicide Control of Safflower in Canola



No Herbicidal Control

Control by Glyphosate

Herbicide Control of Safflower in Barley



Summary

- Shattering resistance reduces the amount of seed deposited in the field
- Harvest losses do occur, (ca. 5% Smith 1996)
- Seed has limited/ no innate dormancy
- Seed predation limits viable seed left on soil surface but may lead to off site dispersal
- Soil incorporated seed germinates rapidly
- Control of volunteer in the year following safflower crop is essential

Summary (2)

- Volunteers are readily controlled by appropriate herbicides, including glyphosate, auxinic herbicides but not glufosinate or ALS inhibitors
- Competitive crops limits success of any volunteers which are not controlled
- Short season crops are usually harvested prior to seed maturity, limiting admixture